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CONTENTS

NEWS AND REVIEWS

OUR COVER PICTURE—*Dr. Frederick J. Stevenson, Principal Geneticist, bagging potato balls at the Plant Industry Station, USDA, Beltsville, Md. See feature article in our* 1956 POTATO HANDBOOK. *Photo by Horticultural Crops Branch, USDA.*

EFFECTS OF SPRAY TREATMENTS ON YIELD RATE AND SPECIFIC GRAVITY OF POTATOES[1]

REINER BONDE AND MILDRED COVELL[2]

INTRODUCTION

The results of considerable research have been published (1, 2, 3, 4, 5) showing the following to be generally true of potato tubers. (1) Americans consider mealiness after cooking to be very desirable. (2) Mealiness is increased by higher starch content. (3) Starch content can be measured by determining the specific gravity; generally the higher the specific gravity, the higher the starch content and the greater the mealiness. (4) Mealiness is influenced by many factors including variety, climate, weather, soil type, fertilizer, cultural practices, length of growing season, storage conditions, and cooking methods.

This paper explains the effects of spray treatments on yield rate and specific gravity. The experiments were conducted in northeastern Maine. Spraying can lengthen the growing period of the vines by reducing injury from diseases and insects. Differences in the length of the growing period of the vines are caused by different spraying or dusting procedures.

The experiments covered by this paper were conducted on Katahdins in 1950, 1951, and 1952, and on Kennebecs in 1951 and 1952. The Katahdin variety is the principal one grown in Maine, and it requires thorough spraying for the control of late blight. Kennebecs are resistant to the common strain of late blight.

METHODS

Usually each spray or dust plot was four-rows wide and 25 feet long. Observations on diseases and insects, determination of yield rates, and sampling for specific gravity determinations were limited to the two middle rows. A peck of tubers selected at random from each plot was put into storage for 8 to 10 weeks and then used for the determination of specific gravity according to the usual method. (Specific gravity = A/A—W, where A = weight in air and W = weight in water.)

EFFECTS OF CERTAIN FUNGICIDES AND INSECTICIDES ON KATAHDINS

Tribasic Copper Sulfate, Bordeaux Mixture, and Nabam

A number of fungicides are commonly used for spraying potatoes in Maine. These fungicides have different effects on plant foliage. Copper fungicides generally give good control of late blight, but may cause some physiological injury to the potato foliage resulting in lower yield rates. The newer carbamate fungicide Nabam (sold under trade names such as Dithane D-14, Parzate, *etc.*) may be somewhat less effective in controlling blight but it does not injure the potato foliage, even when applied at high concentrations. Experiments were conducted to determine if these spray fungicides materially affected the specific gravity and starch content of the tubers produced.

[1]Accepted for publication May 3, 1955.

[2]Plant Pathologist and Technical Assistant, respectively, Maine Agricultural Experiment Station, Orono, Me.

The data in table 1 compare the specific gravity and yield of potatoes from plots sprayed with tribasic copper sulfate, Bordeaux and Nabam, with that of potatoes from unsprayed control plots for the three-year period 1950-1952. These data show some interesting facts. Tubers from the unsprayed control plots, for the years 1950 and 1951, were in most cases lowest in specific gravity. The specific gravity of the potatoes from the unsprayed control plots was significantly lower than that of potatoes from the tribasic copper sulfate, Bordeaux or Nabam-sprayed plots in 10 of the 12 comparisons.[3] The lower specific gravity and the smaller yield rate of potatoes from the unsprayed control plots were due to early killing of the plants by late blight. However, in 1952 late blight was less prevalent. The potato plants in the unsprayed control plots had a longer growing period, and the yield from these plots was comparable to the yield from the sprayed plots. The specific gravity of potatoes from the control plots was not significantly lower than that of tubers from the sprayed plots.

The specific gravity of potatoes from the Nabam plots in field A (table 1, 1950) was significantly lower than that of potatoes from the two copper fungicide plots. The specific gravity of potatoes from the Nabam plots of 1950 was also low in field B although the difference was not significant. The low specific gravity was caused by late-blight infection which resulted in considerable defoliation late in the season. Nabam-treated plots produced tubers with relatively high specific gravity in all tests conducted in 1951 and 1952, when the diseases were controlled satisfactorily. The specific gravity of potatoes from the Nabam plots was significantly higher than that of potatoes from the Bordeaux plots in Field C, 1951, and nearly significant (approaching 5 per cent level) in field A for the same year. The records show that the plants sprayed with Bordeaux were severely injured by aphids causing them to die prematurely and resulting in lower yields and lower specific gravity.

Miscellaneous Fungicides

Table 2 gives the specific gravity and yield rate for certain miscellaneous potato fungicides. In field D (1950) the organic fungicides 1124 and 1189 were used alone and produced potatoes with specific gravities significantly lower than that of potatoes from the tribasic copper sulfate plots The specific gravities of potatoes from plots treated with these fungicides were low in 1951 also, but not significantly so. Plants receiving fungicides 1124 and 1189 produced luxuriant foliage and somewhat better yields in 1950. The fungicides did not give complete control of late blight and therefore the growing period was shortened, a factor which affected both specific gravity and yield.

Both specific gravity and yield were increased by adding tribasic copper sulfate to fungicides 1124 and 1189 in the spray mixtures. The increase in the specific gravity was statistically significant when tribasic copper sulfate was added to fungicide 1124 in 1950, and a slight increase occurred in 1951. A highly significant increase in yield rate was evident when tribasic copper sulfate was added to each of the fungicides 1124 and 1189 in 1951. There was a slight increase in 1950.

[3]All differences in the comparisons of treatments in this paper, which are stated as being significant are so at the 5 per cent level or better.

TABLE 1.—*Specific Gravity and Yield Rate of Katahdins Sprayed with Different Fungicides — 1950-1952.*

Test[4]	Spray Treatment	1950		1951		1952	
		Specific Gravity[1]	Barrels Per Acre[2]	Specific Gravity[1]	Barrels Per Acre[2]	Specific Gravity[1]	Barrels Per Acre[2]
A	Tribasic Copper Sulfate	1.07409	266.5	1.08042	249.2	1.07881	169.2
	Bordeaux Mixture[7]	1.07294	246.2	1.07752	232.9	1.07803	163.2
	Nabam[5]	1.06767	230.1	1.08033	267.6	1.07796	181.1
	No Fungicide[6]	1.06790	224.2	1.07470	208.7	1.07499	177.4
	L.S.D. at 5 per cent Level	.00224	27.5	.00282	28.0	N.S.	N.S.
	L.S.D. at 1 per cent Level	.00297	36.5	N.S.	37.1		
B	Tribasic Copper Sulfate	1.07233	266	1.07980	255.1	1.07602	141.1
	Bordeaux Mixture	1.07245	232	1.08054	256.3	1.07546	143.3
	Nabam[5]	1.07069	247	1.08122	268.4	1.07573	147.0
	No Fungicide[6]	1.06595[3]	218	1.07266	250.1	1.07579	143.1
	L.S.D. at 5 per cent Level	N.S.	12.3	.00286	14.5	N.S.	N.S.
	L.S.D. at 1 per cent Level		N.S.	.00380	19.9		
C	Tribasic Copper Sulfate	1.07320	205.9	1.08248	264.8	1.07976	170.1
	Bordeaux Mixture	1.07273	194.0	1.07461	244.7	1.07943	172.6
	Nabam[5]	1.07512	206.1	1.08389	284.4	1.07921	179.2
	No Fungicide[6]	1.06837[3]	192.0	1.07293	227.3	1.07808	173.3
	L.S.D. at 5 per cent Level	N.S.	N.S.	.00227	14.8	N.S.	N.S.
	L.S.D. at 1 per cent Level			.00302	19.6		

[1]Average for eight 15-pound samples of tubers from eight replicated plots, respectively.
[2]Average from eight replicated 2-row plots, each 25 feet long.
[3]Not included in analyses.
[4]Tests A, B, C indicate different series of comparisons in each year. The nine tests were made in nine different fields.
[5]Nabam did not control blight in 1950 as well as the copper fungicides.
[6]Late blight killed the vines prematurely in 1950 and 1951 in the control plots.
[7]Bordeaux-sprayed plants were killed prematurely by aphids in 1951.

Dust fungicides have been used quite extensively for the control of potato diseases and insects. Tubers from dusted fields were tested for specific gravity and yield in 1950. The data in table 2 indicate that specific gravity of the tubers from the two dust treatments was low in comparison with that of tubers from the copper spray treatments. The comparison of plants from the dusted and sprayed plots was made in similar adjacent fields that had received the same cultural treatments. Dusted plants have a tendency to die earlier than those which have been sprayed. This earlier death of the potato plants may result in a lowering of the specific gravity, but not necessarily of the yield rate (Table 2, field E).

TABLE 2.—*Comparison of specific gravity and yield rate of Katahdins receiving different fungicide treatments — 1950-1951.*

Test	Fungicide	1950 Specific Gravity[3]	1950 Barrels per Acre[4]	1951 Specific Gravity[3]	1951 Barrels per Acre[4]
D	Tribasic Copper Sulfate Spray	1.07279	249.9	1.08042	249.2
	1124[1] (spray)	1.06883	257.9	1.07793	215.1
	1189[2] (spray)	1.06933	251.8	1.07877	232.9
	1124 (50 per cent) and Tribasic Copper Sulfate Spray	1.07170	261.8	1.07817	234.6
	1189 (25 per cent) and Tribasic Copper Sulfate Spray	1.07086	258.5	1.07894	251.6
	No Fungicide	1.06595	224.4	1.07470	208.7
	L.S.D. at 5 per cent Level	.00275	8.78	.00282	10.2
	L.S.D. at 1 per cent Level	.00364	11.94	N.S.	13.5
E	Tribasic Copper Sulfate Talc Dust (7 per cent Copper)	1.06910	262.2		
	Cuprous Oxide Talc Dust (4.1 per cent Copper)	1.06833	263.9		
	No Fungicide	1.06766	274.7		
	No Significant Difference				

[1]Fungicide 1124 is Dinitro phenyl thiocyanate supplied by General Chemical Div., Allied Chemical and Dye Corp., New York, N. Y.

[2]Fungicide 1189 is Oxygenated dimerhexachlorocyclo pentadiene also supplied by General Chemical Division.

[3]Average for eight 15-pound samples from eight replicated plots respectively.

[4]Average from eight replicated 2-row plots, each 25 feet long.

DDT and DDT plus Parathion. Applications of DDT or other insecticides prolonged the growing period of the potato plant. The question arose as to whether the use of an insecticide would alter the specific gravity of the tubers. Table 3 gives the specific gravity of tubers from plants sprayed with the three most widely used fungicides (tribasic copper sulfate, Nabam, and Bordeaux); tubers from plants grown without an insecticide; and tubers from plants treated with DDT and DDT combined with Parathion.

Although the addition of DDT alone and DDT with Parathion to the spray mixtures increased the yield rate and lengthened the growing period of the plants in several cases, the specific gravity was not materially affected. Table 3 shows that in 1950 the addition of DDT to the copper fungicides decreased the specific gravity slightly, whereas the addition of DDT to Nabam decreased the specific gravity significantly. In 1950 the addition of Parathion to Nabam and DDT resulted in a significant increase in specific gravity. In 1951 a significant increase in specific gravity resulted when Parathion was added to Bordeaux and DDT. This increase in specific gravity was associated with better control of aphids due to the use of Parathion.

TABLE 3.—*Specific gravity and yield rate for Katahdins receiving fungicides with and without the addition of DDT or DDT plus Parathion.*

Year	Fungicidal Treatment (Spray)	Specific Gravity[1]			Yield — Barrels per Acre[2]		
		No Insecticide	DDT	DDT and Parathion	No Insecticide	DDT	DDT and Parathion
1950	Tribasic Copper Sulfate	1.07418	1.07409	1.07301	235.6	266.5	255.1
	Bordeaux Mixture	1.07370	1.07294	1.07534	232.2	246.2	247.5
	Nabam	1.07026	1.06767	1.07061	229.8	230.1	247.1
	None	1.06790	1.06844	1.06875	224.2	212.6	212.4
	L.S.D. at 5 per cent Level		.00224			27.5	
	L.S.D. at 1 per cent Level		.00297			36.5	
1951	Tribasic Copper Sulfate	1.08145	1.08248	1.08167	256.5	264.8	280.5
	Bordeaux Mixture	1.08109	1.07961	1.08244	254.8	244.7	262.6
	Nabam	1.08464	1.08389	1.08253	286.6	284.4	285.3
	None	1.07293	1.07455	1.07333	227.3	224.2	219.9
	L.S.D. at 5 per cent Level		.00227			14.8	
	L.S.D. at 1 per cent Level		.00302			19.6	

[1]Average for eight 15-pound samples from eight replicated plots respectively.
[2]Average from eight replicated 2-row plots, each 25 feet long.

THE RELATIONSHIP OF YIELD RATE TO SPECIFIC GRAVITY

The yield rate may vary greatly with the spray mixture, the field location, the year the crop was produced, and other factors. The data in tables 1, 2, and 3 show that high or low specific gravity was not always associated with a correspondingly higher or lower yield. For instance, tubers from plots sprayed with Bordeaux generally have a relatively high specific gravity, but the yields often are less than yields from plots sprayed with tribasic copper sulfate or Nabam. This was illustrated in 1950, as shown in table 1, field B, when tubers from Bordeaux-sprayed plots yielded a relatively high specific gravity and a yield rate that was significantly lower than that of plots sprayed with either tribasic copper sulfate or Nabam. However, low specific gravity is sometimes associated with low yield as shown in table 1, field A, 1951, where Bordeaux treatment resulted in tubers with a lower specific gravity and a significantly lower yield than Nabam treatments. Another example is in field C where the Bordeaux treatment resulted in tubers that were significantly lower in both specific gravity and yield than the tribasic copper sulfate or Nabam sprayed plots.

It also is of interest that plants sprayed with fungicides 1124 and 1189 (table 2, field A, 1950) yielded potatoes with specific gravity determinations lower than those sprayed with tribasic copper sulfate, although the yields of the former were somewhat higher. The tribasic copper

sulfate plots and the cuprous oxide talc dust plots produced relatively large yields but the potatoes had a low specific gravity as you will note in table 2, field E, 1950.

Effects of Certain Fungicides and Insecticides on Kennebecs

Spray Materials

The studies reported here showed that the specific gravity of the tubers of the Katahdin variety was often influenced by the kind of spray fungicide used. Late-blight infection, or other factors which affected the maturity and growth of the plant, also influenced the specific gravity of the tubers. Experiments were conducted during 1951 and 1952 to determine if spray materials would affect the specific gravity of the Kennebec variety in the absence of apparent defoliation by insects or diseases.

The experiments with the Kennebec variety were conducted in the same way as the experiments with Katahdins. It is important to note that defoliation by the late-blight fungus was absent with the Kennebec variety.

Table 4 gives the specific gravity of the tubers and the yields of Kennebec potatoes for 1951 and 1952, from field plots that received different spray treatments.

Although late blight and other foliage diseases were absent in 1951, the specific gravity of potatoes from the field plots which received no fungicide (or only DDT) was significantly lower than the specific gravity of potatoes from the two tribasic copper sulfate treatments. It is important to note that the plots which received no fungicide (or only DDT) gave higher yields than the copper fungicide plots, but not significantly so. Obviously spray applications of tribasic copper sulfate may increase the specific gravity of Kennebec tubers even when late blight is not present in the field.

The data indicate that the addition of DDT to the spray mixture did not affect significantly the specific gravity. This confirms results obtained with the Katahdin variety conducted in 1950, 1951, and 1952.

Table 4 shows that in 1952 there were no significant differences either in the specific gravity or the yields for Kennebecs that had received different spray treatments. There was, however, a trend for the yield from plots sprayed with tribasic copper sulfate to be less than the yield from Nabam plots and the plots receiving no fungicide.

The reason the specific gravity was low in 1951 for the no-fungicide plots is not known. The season of 1951 was characterized by an abundance of moisture and favorable growing conditions which resulted in high yields. The 1952 season was less favorable and the yields were reduced by drought. It is possible that the difference in the growing conditions of the two seasons affected the specific gravity as well as the yields produced.

Summary

The studies reported here were conducted for the purpose of learning if the spray materials used to control foliage diseases and insects, as well as other related factors, affected the specific gravity of potato tubers.

The specific gravity was lowered by any factor which caused pre-

TABLE 4.—*Specific gravity and yield for Kennebecs receiving different spray treatments — 1951-1952.*

Spray Treatment	Specific Gravity[1]		Barrels per Acre[2]	
	1951	1952	1951	1952
Tribasic Copper Sulfate and DDT	1.07680	1.07570	248.8	159.2
Tribasic Copper Sulfate only	1.07698	1.07596	254.4	152.6
Nabam and DDT	——	1.07537	——	164.5
Nabam only	——	1.07493	——	160.1
DDT only	1.07045	1.07547	265.4	163.2
No Spray Treatment	1.06845	1.07592	263.1	159.2
Significance of Tribasic Copper Sulfate *vs.* DDT and No Spray	At 1 per cent Level[3]	None	None	None

[1]Average for eight 15-pound samples of tubers from eight replicated plots respectively.
[2]Average from eight replicated 2-row plots, each 25 feet long.
[3]For 1.06845 and 1.07045 *vs.* 1.07680 and 1.07698.

mature death of the potato plants. Among these factors were defoliation by the late-blight disease and by insect infestation. A spray program that gave good control of disease and insects not only raised the specific gravity, but also tended to give better yields.

Bordeaux and tribasic copper sulfate generally produced potatoes with high specific gravity provided late blight was controlled, but those fungicides had a tendency to decrease the yields in comparison with the other fungicides. The specific gravity of potatoes from plants sprayed with Bordeaux was lowered when injured by excessive feeding of insects.

In 1951 Katahdins from unsprayed field plots were low in specific gravity. However in 1952, when late-blight infection was less severe, the specific gravity was not lowered significantly by the absence of fungicide applications.

Nabam (trade names Dithane D 14 or Parzate), also produced tubers that were significantly low in specific gravity in 1950 as the foliage was injured by late-blight infection.

Two newly-developed experimental fungicides (1124 and 1189), as well as tribasic copper sulfate and cuprous oxide-talc dust fungicides, produced low-starch potatoes. The plants sprayed with these two new fungicides were partially defoliated by late blight, but the dusted plots matured rather early in the season with little or no disease present.

In these studies applications of DDT did not affect significantly the specific gravity of potatoes although DDT and Parathion in combination did increase the specific gravity of potatoes from plots sprayed with Bordeaux when aphids were prevalent.

Potatoes with high specific gravity were not always prone to high yields. The potatoes from fields sprayed with Bordeaux generally had rather high specific gravity. Yields from plots sprayed with Bordeaux were somewhat smaller than yields from tribasic copper sulfate and Nabam-sprayed plots. Fungicides 1124 and 1189 produced tubers with low specific gravities in 1950, although the yields were somewhat greater than yields from Nabam, tribasic copper sulfate, or Bordeaux sprayed plots.

A long growing season was favorable for the production of potatoes with high specific gravity. Shortening the growing period by an inadequate spray program, or by any other means, resulted in potatoes that were lower in specific gravity .

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ANTIGO:[1] A NEW WHITE, MEDIUM-MATURING POTATO VARIETY RESISTANT TO COMMON SCAB

G. H. RIEMAN[2] AND DONALD A. YOUNG[3]

The Agricultural Experiment Station of the University of Wisconsin released a new scab-resistant variety of potatoes named Antigo.

The common scab disease of potatoes, caused by *Streptomyces scabies* (Thaxt.) Waksman and Henrici, is an important limiting factor in the production of high quality potatoes in various parts of the United States and Canada. It remains one of the least satisfactorily controlled potato diseases. Some production areas in Wisconsin and elsewhere have been forced to discontinue the growing of potatoes because of the ravages of this disease. Once established, the scab-causing organism can subsist indefinitely in favorable soil. The soils of new potato producing farms or entire areas are often free from the causal organism. The pathogen may gradually become established under average farming procedures by means of infected seed tubers and by means of wind or water movement of infested soil. Various control measures involving seed treatment, crop rotation schedules and soil amendments have been developed and used extensively to protect the crop from common scab. These remedial measures have been found to be only partially successful in the important potato production regions where soil and climatic conditions are known to be favorable for scab development. Their effectiveness in the main has been limited to retarding the progress of this endemic disease.

It is now recognized that the scab organism is exceedingly variable and that many different physiologic races exist. This fact may account in part for the lack of reliable control measures.

Growers have found that one of the best ways to combat scab is through the use of tolerant or resistant varieties. The old Russet Rural variety was grown extensively for more than a quarter of a century because it was less susceptible to scab than other standard varieties available at the time. More recently the Russet Burbank and the Russet Sebago have replaced the Russet Rural in areas of Wisconsin where scab has been troublesome. Unfortunately, all three of these varieties possess only a limited amount of resistance to the disease and they are not successful under conditions extremely favorable for scab. A much higher level of resistance to scab was found by Schlumberger (1) (2) in Germany in 1927 in certain European varieties. Some of these European scab-resistant potatoes were brought to America by the Division of Plant Exploration and Introduction of the United States Department of Agriculture. Research workers in the National Potato Breeding Program found the varieties Jubel, Hindenburg, Arnica and Ostragis developed in Germany and in other European countries to be highly resistant to the races of the scab organism commonly occurring in the United States. Although these foreign varieties are of no value in American potato culture as such, they

[1]Accepted for publication May 3, 1955.
Antigo, the name of a city in Langdale County, Wis.

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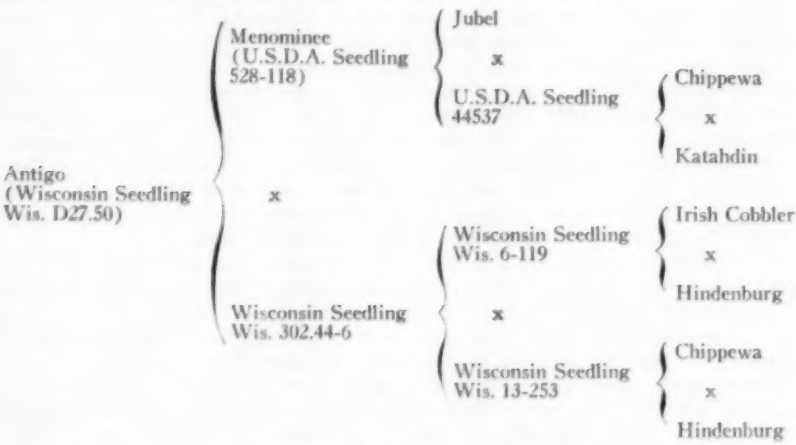
Paper No. 585 from the Department of Genetics, University of Wis., Madison, Wis.

have been found to be exceptionally useful as parents in crosses with domestic sorts.

Scab-resistant varieties derived from these European breeding stocks include Antigo, Cherokee, Ontario, Seneca, Cayuga, Menominee and Yampa. Of these, Cherokee and Ontario are being used in commercial production in the Middle West. Early Gem is the only highly scab-resistant variety recently introduced in America which has not been derived from the European scab-resistant breeding stock importations made some twenty-five years ago by the Division of Plant Exploration and Introduction of the United States Department of Agriculture. Two scab-resistant varieties from Germany — Hindenburg and Jubel — occur in the pedigree of the new variety ANTIGO. The scab-resistant U.S.D.A. seedling of American origin also occurs in the pedigree of Antigo.

PEDIGREE OF THE ANTIGO VARIETY



DESCRIPTION AND EVALUATION

Antigo is a medium-maturing scab-resistant variety possessing average yielding ability. It is earlier than Katahdin and somewhat later than Irish Cobbler. It is especially adapted to muck soils in Wisconsin. The round white tubers tend to form early and have tough well-matured skins at harvest time. The tubers separate readily from the vines. For these reasons the tubers of the new Antigo variety appear to be adapted to mechanical harvesting. Its tubers are smoother and have a more attractive shape than those of Irish Cobbler. The tubers are inclined to be more irregular than those of Katahdin under adverse growing conditions.

Antigo plants have an open semi-upright habit of growth. Plant size is somewhat smaller than Irish Cobbler. The tubers are set deep in the soil on short rhizomes. The variety handles well with modern potato growing equipment. The Antigo variety (Wis. D27.50) has been under observation and trial in Wisconsin and in neighboring states for a period of eight years. It has consistently shown high resistance to scab. The results presented in table 1 show that Antigo possesses considerably more

TABLE 1.—*Reaction to common scab of Antigo compared with the behavior of susceptible, tolerant and resistant potato varieties grown on scab-infested soil over a period of seven years.*[1]

Location and Year	Scab Readings[2]			
	Resistant Antigo	Susceptible Irish Cobbler	Tolerant Russet Burbank	Resistant Hindenburg
Antigo, Wis. 1948	1-2	3-3	—	—
" " 1949	2-2	3-4	—	—
" " 1950	2-2	3-4	3-3	1-2
" " 1951	1-1	3-4	2-2	T-1
" " 1952	2-1	4-4	2-2	1-1
Starks, Wis. 1953	2-2	3-4	2-3	T-1
" " 1954	2-2	5-4	3-3	1-1

[1]Based on 5-hill samples.

[2]First figure indicates area:
T = Trace
1 = 1-20 per cent surface covered.
2 = 21-40 per cent surface covered.
3 = 41-60 per cent surface covered.
4 = 61-80 per cent surface covered.
5 = More than 80 per cent of surface area covered.

Second figure indicates type of lesion:
1 = Surface (russet) type.
2 = Raised surface or shallow pit.
3 = Pitted scab.
4 = Deep pits.

resistance to scab than the tolerant Russet Burbank variety. The level of scab-resistance, however, is not equal to that found in its highly resistant ancestor, Hindenburg, from Germany. Similar tests in Wisconsin with the seven recently introduced American scab-resistant varieties, in comparison with the highly resistant European stocks, indicate that their level of scab-resistance is not equal to the best foreign varieties. Therefore, domestic varieties with higher resistance to scab may be anticipated from the state and federal potato breeding programs.

The Antigo variety was included in the North Central Regional Potato Trials during 1953 and 1954. The yields of U. S. No. 1 potatoes and percentage of solids of Antigo and the four standard varieties Cherokee, Katahdin, Irish Cobbler and Triumph obtained in eight north central states during 1953 are presented in table 2. The five varieties were fairly similar in their average yielding ability ranging from 226 bushels per acre of U. S. No. 1 potatoes for Katahdin to 255 bushels of U. S. No. 1 potatoes for Irish Cobbler. Cherokee and Irish Cobbler produced the highest average total solids or dry-matter content with percentages of 19.1 and 19.0 respectively. Antigo and Katahdin followed with an average total solids percentage of 18.1 and Triumph produced a low average total solids percentage of 16.7. Similar results regarding yields and dry-matter content were secured in the North Central Regional Potato Trials during 1954.

TABLE 2.—*Yields and percentage of solids of Antigo compared with those of standard varieties grown in the North Central Regional Potato Trials, 1953.*

Location	Antigo	Cherokee	Katahdin	Irish Cobbler	Triumph
Yields per Acre U.S. No. 1	Bus.	Bus.	Bus.	Bus.	Bus.
North Dakota	230	227	130	341	273
South Dakota	177	221	167	221	155
Minnesota	85	64	83	97	108
Wisconsin	434	391	364	554	565
Michigan	221	327	404	290	332
Nebraska (Mitchell)	269	233	316	202	222
Nebraska (Cezad)	258	166	163	351	355
Iowa	185	190	238	243	187
Indiana	368	362	172	0[1]	18
Average	247	242	226	255	246
Total Solids (Dry-matter Content)	Per cent	Per cent	Per cent	Per cent	Per cent
North Dakota	18.4	19.1	17.9	19.9	17.4
South Dakota	16.9	18.2	15.8	16.5	14.3
Minnesota	19.9	18.4	18.9	21.9	18.2
Wisconsin	19.7	22.4	20.9	21.2	19.4
Michigan	18.9	19.1	19.4	20.1	17.6
Nebraska (Mitchell)	20.4	21.2	19.9	20.4	17.9
Nebraska (Cezad)	15.5	16.2	14.7	13.8	14.3
Iowa	16.7	18.6	17.7	17.7	15.0
Indiana	16.7	18.4	17.7	19.7	16.0
Average	18.1	19.1	18.1	19.0	16.7

[1]No U.S. No. 1 potatoes due to heeavy scab infection.

SUMMARY OF ANTIGO CHARACTERISTICS

1. Resistance to common scab.
2. Mid-season maturity.
3. Tubers white, uniform in size, attractive shape, tough skin.
4. Total solids similar to Katahdin.
5. Tubers set deep in the soil on short rhizomes.
6. Average yielding ability.
7. Plants small to medium size, open growth habit.

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IMMUNITY TO VIRUS X IN POTATO: SELECTION OF IMMUNE PLANTS IN THE BREEDING PROGRAM[1]

ROLAND G. TIMIAN,[2] C. E. PETERSON[3] AND W. J. HOOKER[4]

Virus X is one of the most important viruses of potato because it is universally present in all seed stocks of certain susceptible varieties and widely distributed in the seed stocks of many others. At present, no large stocks of X free potato seed are available for commercial use in this country and only one immune variety of suitable commercial type, Saco, has as yet, been released (1). Resistance to virus X in potato has recently been reviewed (3) and a brief report of the work reported herein has been made (8). This paper describes procedures for mass inoculation of small seedling potatoes in selecting virus X immune plants in the breeding program.

Relatively few advances in techniques of breeding for virus X immunity have been made following identification of immunity in seedling S 41956 (7) and identification of the abnormal graft reaction of X immune stocks (5). Selection of immune segregates in a breeding program is dependent upon a means of rapidly and efficiently eliminating susceptible individuals from large populations.

Factors influencing symptom expression of the virus in X free susceptible potatoes propagated as clonal lines (9) and in populations of young seedling plants (10) were investigated. The mechanical inoculation test was at least as reliable as the graft test of Raleigh and had the advantage of greater ease of testing and economy of space. Furthermore, the mechanical inoculation test could be applied to small potato plants grown from true seed whereas the graft test could not. Reliability of symptom expression in susceptible potatoes mechanically inoculated with virus X was dependent upon the virulence of the isolate selected for inoculation. When suitable ring spot strains of virus X were used, symptoms in susceptible plants consisted of local necrotic spotting of inoculated leaves and a systemic top necrosis, whereas immune plants showed no reaction. The most effective isolate incited visible local and systemic symptoms on all susceptible plants tested making it relatively simple to eliminate susceptible plants from large populations of small seedlings in greenhouse flats prior to transplanting.

Results reported by Timian, Hooker and Peterson (10) were based upon seedling plants individually inoculated by rubbing the leaves with

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an inoculum-carborundum mixture. In order to develop inoculation procedures for large numbers of seedling plants in the breeding program, mass inoculation methods similar to those of McKinney and Fellows (4) and Richards and Munger (6) were employed.

Materials and Methods

Inoculum was prepared by expressing the sap from *Nicotiana glutinosa* L. infected with either of two ring spot strains of virus X, X5, or XRS,[5] and diluting 1 part with 10 parts of water. Carborundum 400 mesh was generally used except where carborundum 120 mesh and filter grade Celite were compared.

Mass inoculation of seedling plants was accomplished when 2 true leaves were showing by forcibly ejecting from a paint spray gun[6] (Figure 1) an inoculum-carborundum mixture on the small plants. This was compared to a carborundum blower which consisted of a powder duster modified by inserting a drawn glass tube into the tip. Plants were sprayed first with an inoculum suspension, and while they were still wet, carborundum was forcibly ejected on the leaf and stem surface.

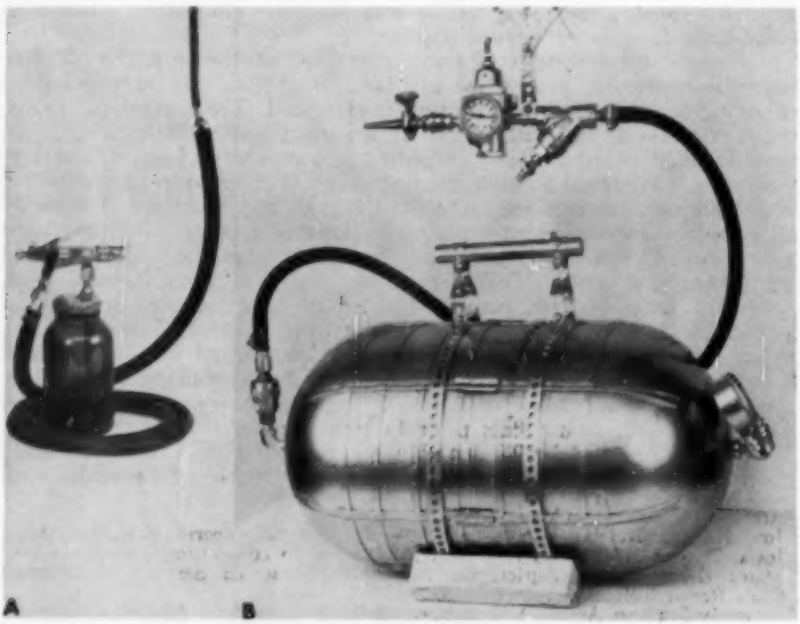

Figure 1.—A-Paint spray gun for inoculating with virus X by applying an inoculum-carborundum mixture to leaf surfaces. B-Tank for compressed air with pressure reducer. Photographs by R. E. Wicklund.

[5]XRS was a severe ring spot isolate of virus X obtained from R. H. Larson of the Department of Plant Pathology, University of Wisconsin, Madison, Wis.
[6]DeVilbiss type A C gun with a type G nozzle.

Pressures of 15 pounds per square inch for inoculating plants were maintained with 2 types of pressure tanks which served equally well. One type was a U. S. Army surplus oxygen tank fitted with a pressure reducer at the outlet and filled with compressed air. A second source of pressure which proved equally satisfactory was a tank of liquid carbon dioxide fitted with a pressure reducer.

Ia. 873, a uniformly susceptible potato progeny resulting from a cross of two susceptible parents (B762-31 and Ia. 44-1-21), was used in this study.

Experimental Results

Four similar replicated trials using different types of mass inoculation procedures were made and results were in general agreement. In a typical trial (Figure 2), plants were inoculated at the second true leaf stage using either the paint spray gun or the carborundum blower. With the paint spray gun the abrasive type and concentration as well as plant to nozzle distance were varied.

The carborundum blower was least effective since a rather low percentage of plants became infected. Furthermore, the amount of plant injury was often severe and the degree of injury varied considerably between tests.

Carborundum 400 mesh, 12 grams per 100 milliliters of inoculum, was more effective when used with a plant to nozzle distance of 1 centimeter than when used at a 10 centimeter distance. Mechanical injury to the plants was negligible when the nozzle was moved continuously. When 6 grams carborundum were used per 100 milliliters of inoculum, infection was less than at the higher concentration. Celite under the conditions tested was slightly less effective than the best carborundum treatment. In other tests, 150 mesh carborundum was tried, but the extent of plant injury was considerable and the percentage of infection was low.

Following certain treatments, local necrotic lesions first appeared in 6 days and systemic symptoms usually developed a few days later (Figure 3). A few of the susceptible plants did not develop infection until the third week after inoculation. When disease became evident, susceptible individuals exhibiting local or systemic symptoms were removed from the seedling stand.

A second inoculation with virus X was made by hand after seedling plants had been transplanted to the greenhouse bench. Leaves of plants were gently rubbed between the thumb and forefinger which had been moistened with an inoculum-carborundum mixture. For this, the inoculum was diluted 1 part with 10 parts of water and a small amount of carborundum was added. Carborundum was also dusted on the leaf surface before inoculation. Plants expressing symptoms were removed during the growing season.

Efficiency of this method of inoculation was established in the breeding program. A number of tests were made and the results of only one large trial are reported. From several progenies segregating for immunity to virus X, 6745 plants were inoculated by the spray gun method with a severe strain of virus X. Of these, 2160 plants or 32 per cent expressed symptoms of the virus in the form of necrotic spots. After transplanting,

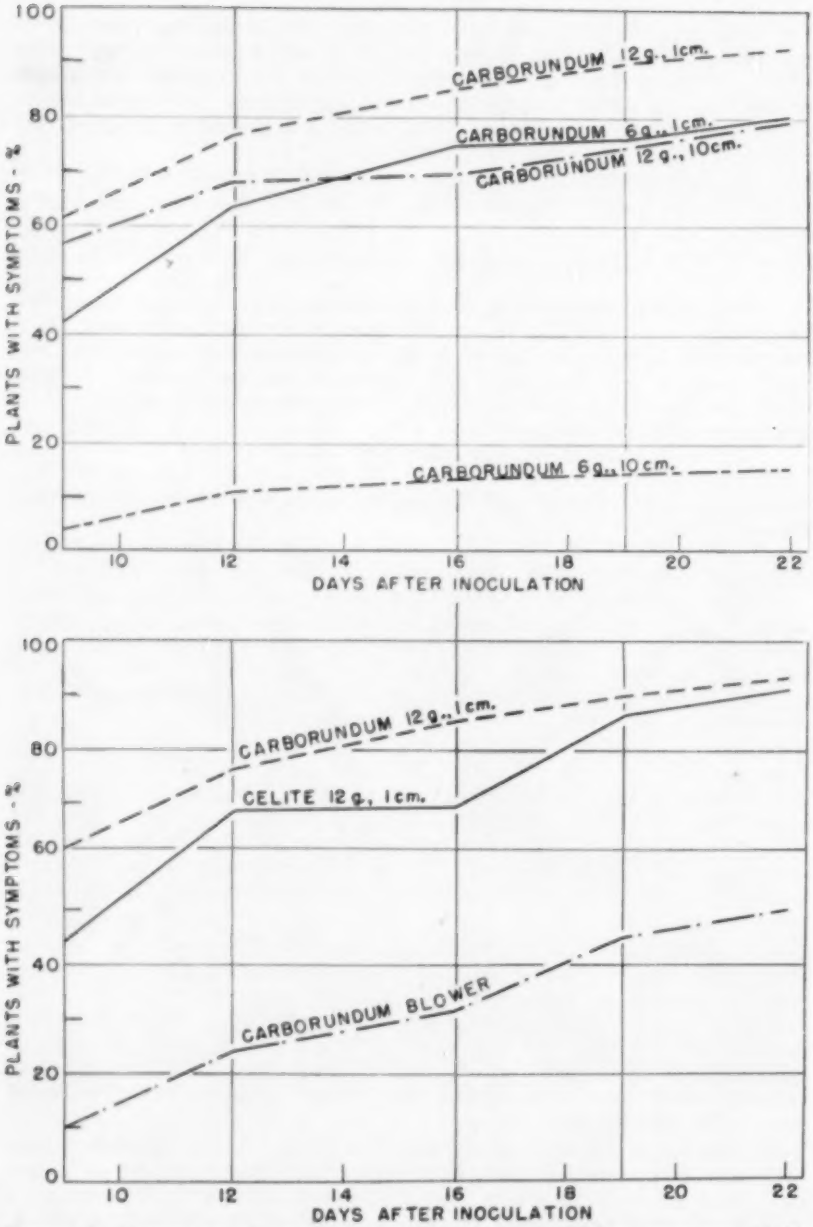

FIGURE 2.—Percentage of susceptible seedling plants exhibiting symptoms of X infection when inoculated by different methods. For the paint spray gun the abrasive concentration (gms. per 100 ml. of inoculum) and nozzle to plant distance (cm.) are given.

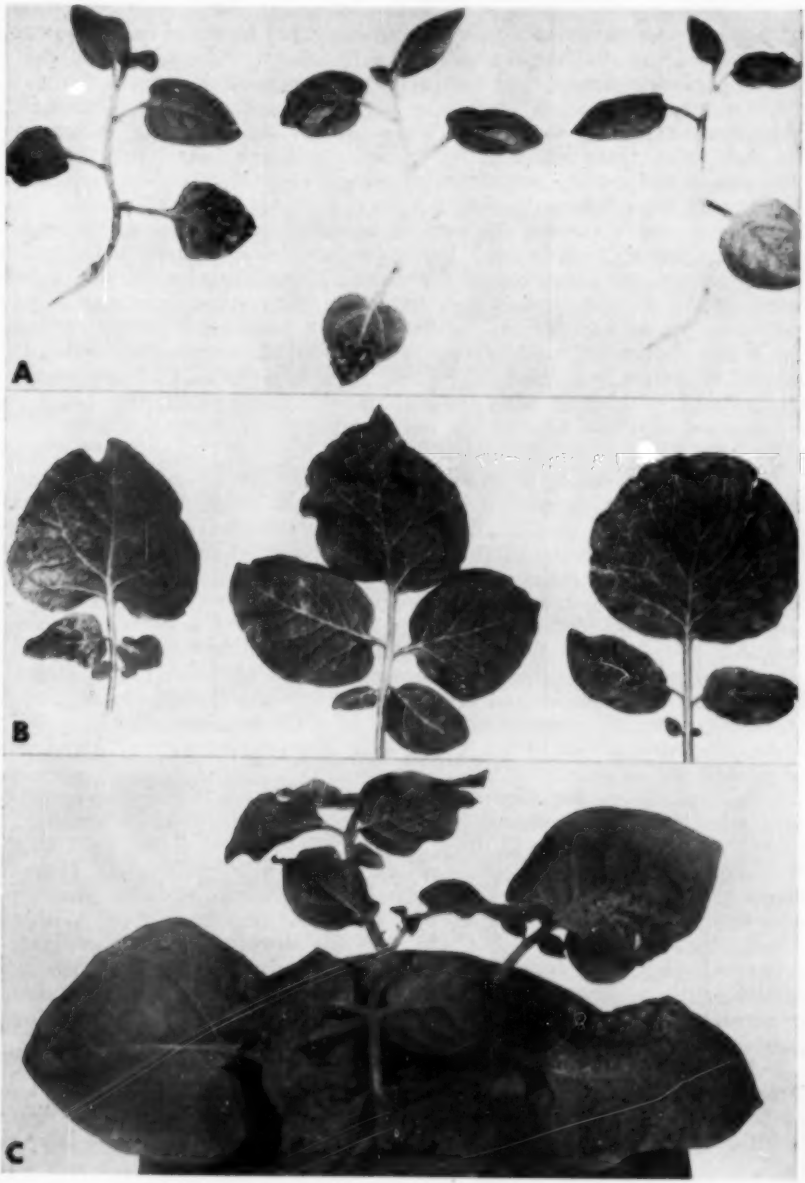

FIGURE 3.—A-Local lesions and systemic necrosis in seedling potato plants following inoculation with paint spray gun. B- and C- Symptoms of systemic necrosis and mottle which developed after the plants were transplanted to 3-inch pots.

the remaining symptomless individuals were inoculated a second time by rubbing the leaves of every plant with an inoculum-carborundum suspension as described previously. An additional 405 or 8.8 per cent of the surviving plants that had apparently escaped inoculation in the seedling stage expressed symptoms of the virus and were discarded. Individuals surviving these tests were planted the following season in the field and those of suitable horticultural type were selected for observation and testing again the following year. Of those selected over 90 per cent were immune to virus X.

During the course of the work it became apparent that unless seedlings were carefully examined following inoculation certain individuals became symptomless carriers of the virus. When large populations were being grown in the greenhouse, frequent and careful examination of individual plants was difficult. In the breeding program, plants surviving the X inoculation test were planted in the field. Those selected for horticultural type were inoculated a third time, examined carefully for symptoms, and tested for latent X using the serological method of Bradley (2).

Discussion

In a potato breeding program it is possible to develop potato selections which carry the type of immunity to virus X originally described in S 41956 (7). This type of resistance has certain advantages over the field immune or hypersensitive type of resistance which has been incorporated in many X-resistant commercial varieties grown in continental Europe and the British Isles. In breeding for the latter type of resistance, seedlings must be increased until duplicate plants of a clonal line are available. One plant is used to maintain the clonal line and the second plant is inoculated in evaluating resistance to the virus. Suitable resistance is manifest by necrosis and death of the plant following inoculation. In contrast, when immunity of S 41956 is evaluated, immune plants fail to become infected with virus X following inoculation and may therefore be propagated at once.

In preliminary investigations it was determined (9) that symptom expression following mechanical inoculation of potato plants grown from tubers could be used to identify X susceptible clonal lines. Reliability of these tests was dependent upon the isolate of virus X used. Potato plants grown from true seed (10) could be tested in a similar manner with immune plants exhibiting no symptoms following inoculation. Within a temperature range of 16° C. to 24°, all susceptible seedling plants developed symptoms following inoculation with suitable isolates of virus X. Mass inoculation procedures similar to those used in breeding for resistance to viruses in other crops were very effective in these tests with seedling potatoes.

During the course of the work, the program of breeding for X immunity was gradually expanded from a few flats in 1949 to 43 progenies in 1950 when more than 10,000 seedling plants survived the seedling inoculations and approximately 7,000 tested plants were planted in the field.

Summary

In a program of breeding potatoes immune to virus X, mass inoculation of seedling plants using suitable isolates of virus X was effective in

identifying susceptible individuals. Expressed sap from X infected *Nicotiana glutinosa* L. diluted 1-10 with water was mixed with 12 grams of 400 mesh carborundum per 100 milliliters of inoculum. The inoculum-carborundum mixture was sprayed on the seedling plants when two true leaves were showing. For this, a paint spray gun was used with a pressure of 15 pounds per square inch and a plant to nozzle distance of approximately 1 centimeter.

Symptomless plants surviving mass inoculation were transplanted to 3-inch pots in the greenhouse bench and when growing well they were inoculated a second time by hand. Plants developing either local or systemic symptoms of X infection were discarded. Symptomless, X-immune individuals were propagated further. Serological tests for identifying symptomless carriers of virus X were useful in further evaluation of advanced selections.

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STEM STREAK NECROSIS OF POTATO IN PRINCE EDWARD ISLAND[1]

D. B. ROBINSON[2] AND L. C. CALLBECK[2]

INTRODUCTION

A stem streak necrosis of potato, associated with acid soils, was reported in Long Island in 1932 (7), and has since been described in Wisconsin (1, 2), and in Holland (4). The disease is also commonly called 'land streak' or 'stem break.' It is characterized by a stunting of plants, the loss of bright green color, and a flecking or streaking of stalks and petioles. The affected parts may become brown and very brittle, so that defoliation often accompanies the progress of symptoms. In severe cases, plants die prematurely. Potatoes are very sensitive to excess manganese (4), and it has been shown that stem streak necrosis may be caused by manganese toxicity (2, 4). (Figure 1.)

Each year numerous cases of stem streak necrosis occur in commercial fields of potatoes in Prince Edward Island, and most commonly in the widely-grown varieties Irish Cobbler and Sebago, but no previous investigation of the disorder has been made in this province. The purpose of this paper is to present evidence on the cause of stem streak necrosis in Prince Edward Island, and to report on trials on control and on varietal susceptibility.

MATERIALS AND METHODS

All experiments carried out in field plots were on areas where the disease was known to occur with uniform severity, and those in the greenhouse were with soil collected from such areas. Randomized block designs were used in all tests. All seed tubers were of Foundation grade, and were usually treated with a surface disinfectant before planting. Standard cultural and spraying procedures were followed. No other diseases of any consequence appeared in the plantings, and no streaking or lesioning of the stems, resulting from other diseases or conditions, occurred.

Stem streak was recorded as an index, expressed as per cent, and obtained by rating the plants according to the scale of increasing severity 0-1-2-3, weighting the figures, and converting their summation to an index expressed as a percentage of the total score possible.

PRELIMINARY TRIALS

It was noted that the most severe cases of the disease occurred in naturally acid areas of light soil. On many of these areas, the disease was found in irregular patches, and often on individual, scattered plants. The pH of composite soil samples from beneath such affected plants was

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FIGURE 1.—Stem streak necrosis in the variety Cherokee, with typical leaf drop.

compared with that of soil from beneath adjacent healthy plants in ten potato areas, and it was found that the soil from beneath diseased plants was the more acid in each of these areas. Respective pH ranges were 4.59-4.93 and 4.72-5.38.

Further evidence of the relationship between stem streak and soil acidity was obtained in a field trial. Three pH levels were secured by applying sulphur at 500 pounds per acre to one plot series and limestone

at 2000 pounds per acre to a second series; a third series received no amendment. Each plot was split to include two rates of 5-10-13 fertilizer, one of 1,000 pounds per acre, the other of 3,000 pounds per acre. Four replicates were used, with each plot consisting of 75 plants. Stem streak began to appear in 67 days, and became most severe in 90 days. A comparison of disease severity and soil pH is given in table 1, and shows that streak is most severe when pH is low, and that a high level of fertilization reduces the prevalence of the disease. Individual plot comparisons of pH and disease indexes showed that when pH values reached 5.0 or higher, stem streak symptoms were slight.

TABLE 1.—*The effect of two fertilizer rates combined with lime and sulphur amendments on soil pH and on stem streak necrosis.*

Treatment	1000 Lb/Ac 5-10-13		3000 Lb/Ac 5-10-13	
	Streak Index	pH	Streak Index	pH
Check	32.7	4.9	12.8	5.1
Limestone	4.2	5.3	9.0	5.4
Sulphur	80.3	4.5	11.0	4.7

The role of manganese in causing stem streak was studied in field plots with Cherokee as the test variety. The experiments also included the nutrients molybdenum, zinc, and magnesium because these were known to be important in crop production in the province. In one trial, drill applications of magnesium sulphate at 20 pounds per acre, and of sodium molybdate at four pounds per acre did not, either separately or in combination, reduce the severity of symptoms. On the other hand, manganese sulphate at 20 pounds per acre increased the severity of symptoms, not only when applied alone, but also when combined with either or both of the other salts. This effect was studied further in a second trial in which manganese was tested comparatively with zinc, magnesium and molybdenum. The test area was given a light dressing of 5-10-13 fertilizer, and the micronutrients were applied to the rows before planting. The data, given in table 2, were taken from 120 plants per plot in a six-replicated trial. No significant differences occurred, but the importance of manganese in inciting streak and depressing yield was indicated.

The effect of manganese in inciting streak, and of lime in counteracting it, was tested further in the greenhouse on two soil samples. On both samples, two soil amendments were studied: limestone at 4,000 pounds per acre, and manganese sulphate at 100 pounds. Cherokee was used as the test variety. The results, presented in table 3, show that the addition of manganese sulphate accentuated stem streak symptoms, and exerted its greatest influence in the soil with the higher pH value; limestone completely prevented the disease.

The results of these experiments indicate that stem streak necrosis of potato is associated with acid soils; and is specifically caused by excess of soluble manganese, occurring at low pH levels.

TABLE 2.—*The effects of manganese, zinc, magnesium, and molybdenum applications on stem streak necrosis.*

Treatment	Rate per Acre (Pounds)	Stem Streak Index	Yield Bus/A.
Check		46.5	116.6
$MnSO_4 . 2H_2O$	100	57.5	84.6
$ZnSO_4 . 5H_2O$	20	45.2	122.1
$MgSO_4 . 7H_2O$	20	49.1	126.9
$Na_2MoO_4 . 2H_2O$	4	43.0	120.8
Zn and Mo Salts	20-4	44.8	133.5
Mg and Mo Salts	20-4	45.9	117.9
Zn and Mg Salts	10-10	44.1	120.5
Zn, Mg, and Mo Salts	10-10-4	38.1	118.5

TABLE 3.—*The effect of applications of lime and of manganese sulphate on stem streak necrosis.*

Treatment	Soil Sample I[1]		Soil Sample II[2]	
	Streak Index	pH	Streak Index	pH
Check	7	5.50	23	4.91
$MnSO_4 . 2H_2O$ 100 Lbs./ac.	70		26	
Limestone 4000 Lbs./ac.	0	6.62	0	6.23

[1] 21 plants per treatment.
[2] 20 plants per treatment.

EFFECT OF LIME APPLICATIONS

An area, unsuitable for potato production because of the severity of stem streak, was treated with limestone at three rates to determine what control of the disorder might be given by this soil amendment under field conditions. The variety Sebago was planted immediately following the applications of lime. Readings on stem streak were made 85 days after planting, and the comparisons are presented in table 4. Significant decreases in the severity of the disease were obtained by applications of one-half and of one ton of limestone per acre. These rates changed the pH of the soil from 4.70 to 5.08 and 5.30 respectively.

VARIETAL SUSCEPTIBILITY

Twelve commonly grown varieties of potatoes were tested for comparative susceptibility to stem streak necrosis on an area where Sebagoes had been uniformly and severely affected in a previous year. Symptoms began to appear 65 days after planting, and final disease readings were taken after 78 days. The results, given in table 5, show distinct differences in varietal susceptibility. Field survey records support these findings in

TABLE 4.—*The effect of current-year applications of limestone on stem streak necrosis.*

Limestone Lbs/Acre	Stem Streak Index	Converted[1] Index	Soil pH
Check	57.8	49.8	4.70
500	46.2	42.4	4.85
1000	23.5	27.6	5.08
2000	8.0	15.2	5.30
L. S. D. at P = 0.05		13.3	

[1]Expressed as 'angle' figures for statistical comparison.

TABLE 5.—*Field susceptibility of some potato varieties of stem streak necrosis.*

Variety[1]	Stem Streak Index	Converted[2] Index	Variety	Stem Streak Index	Converted Index
Irish Cobbler	68.5	56.5	Netted Gem	13.3	19.2
Cherokee	52.7	46.6	Pontiac	3.5	8.2
Sebago	46.4	43.0	Warba	1.0	2.9
Kennebec	39.0	38.0	Canso	0.0	0.0
Keswick	28.3	31.0	Green Mountain	0.0	0.0
Katahdin	16.1	21.8	McIntyre	0.0	0.0

L. S. D. at P = 0.05 7.7

[1]400 plants per variety in an eight-replicated trial.
[2]Expressed as 'angle' figures for statistical comparison.

that stem streak has been reported only for the varieties Cherokee, Chippewa, Irish Cobbler, Sebago, Kennebec, and Keswick; it has not been found in Canso, Green Mountain, and McIntyre.

DISCUSSION

The results show that stem streak necrosis of potato in Prince Edward Island occurs only on very acid soils, and is probably a direct effect of manganese toxicity. This is in accord with results obtained in Wisconsin (1, 2). It affords an explanation for the common occurrence of the disease on sandy or low-lying areas, in newly cultivated land, and in dead furrows or along hedgerows, since the soil is generally very acid in all locations of this type.

Field applications of magnesium, zinc, and molybdenum had no effect on the disease, although it has been reported that magnesium may reduce the injury in potato caused by excess manganese (4), and that molybdenum and manganese may be antagonistic (5). A high level of N-P-K fertilizer, however, was quite beneficial in reducing the severity of stem streak, and the result indicates that an unbalanced supply of nutrients is the

basic cause of the disorder. Increments of phosphorus have been reported to reduce the uptake of manganese by potato plants (3), so in this trial the benefit of heavy fertilizer application may have resulted from the antagonistic action of manganese and phosphorus.

Lime applications markedly reduced stem streak but the disease was not entirely prevented in the field even when pH levels were raised to 5.3. No common scab occurred in these trials; but the danger of inducing scab by applications of lime that raise soil pH above 5.0 emphasizes the importance of the use of varieties resistant to stem streak necrosis in conjunction with moderate applications of lime.

Summary

Evidence is presented that a stem streak necrosis of potato in Prince Edward Island is associated with acid soils and an excess of manganese. Liming and high fertility markedly reduced disease severity. The varieties Cherokee, Irish Cobbler, and Sebago are very susceptible, whereas Canso, Green Mountain, and McIntyre are very resistant to the disease.

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ABSTRACTS OF PAPERS PRESENTED AT THE 39th ANNUAL MEETING
September 6-8, 1955 — East Lansing, Michigan

(*Continued from October*)

KING, J. R.

IRISH POTATO POLLEN STORAGE

This is to be considered as a progress report which deals with continued studies on Irish potato pollination and the handling of pollen for pollination purposes.

Short period storage is the storage of batches of pollen which are being used for pollination. Vials of currently used potato pollen will keep in a household refrigerator or in a similar storage place with a temperature roughly between 35 and 45 degrees Fahrenheit. Pollinations during the 1954 and 1955 breeding seasons in Louisiana indicated that when pollens are strong, they can be used repeatedly for a week or more before being replaced.

Long-period storage of pollen is concerned with the longevity of any batch of pollen over a period of months, or years, during which time it is not handled. Thirty-one combinations of temperature and humidity were used in the long-period storage test at Louisiana State University, which was started April, 1954. The purpose of the test was to determine the longevity of potato poliens, in view of their storage from season to season for breeding work. Viability of the stored pollen was checked periodically by germination in a 2% agar-13.5% sucrose medium.

The results of the viability tests seem to indicate that, among the various storage environments used, longevity of the stored pollens has, thus far, been best, by far, at minus-30 degrees F. with no controlled humidity. The second best storage environment has been 35 degrees F. with a relative humidity of 18.6%.

A real problem in the study of pollen handling is the reliable estimation of the amount of viability of a batch of pollen. Germination percentages of potato pollens can be expected to give an indication that a pollen is living; but the erratic reaction of potato pollens to artificial media make these percentages necessarily not reliable in regard to the actual potency of a pollen at any one time, particularly in view of that potency in pollinations.

The set of seed-balls from all pollinations made with 1955 pollens was 5%, while the set from those made with stored (1954) pollens was 22.7%. The average set of seed-balls from successful pollinations with 1955 pollen was 29.8%, while the average set with stored (1954) pollens was 34.4%.

The practicality of pollen storage centers, shipment of potato pollens, and exchanges of pollens among potato breeders are mentioned.

LARSON, R. H.

POTATO VIRUS S — A NEW PROBLEM FOR THE VIROLOGIST, SEEDSMAN AND BREEDER, A REVIEW

The early preliminary reports on the "new" potato virus S were from the Netherlands by Maria P. de Bruyn Ouboter in 1951, E. van Slogteren in 1952 and A. Rozendaal in 1952. More recent work on virus S has been reported by A. Rozendaal in 1954, J. H. Brust and A. Rozendaal in 1954 from the Netherlands, George Cockerham from Scotland in 1954, C. Wetter and J. Brandes in 1955 from Germany, R. H. Bagnall and R. H. E. Bradley from Canada in 1955, and C. E. Yarwood and A. H. Gold in 1955 from the U. S.

The "new" potato abnormality was first observed by seed growers in 1949, in the northern foundation seed fields in the Netherlands, in the varieties, Bintje and Eigenheimer. The disease as a virus was detected by E. van Slogteren in 1950, at the Laboratory for Flowerbulb Research at Lisse, during an attempt to prepare an antiserum against potato virus A using the variety Industrie as a source material. As a result, the new potato virus was named "S" after E. van Slogteren.

Since then, a large number of potato seed stocks of most varieties from all areas of Europe, when tested serologically for the presence of virus E, have been shown to carry a high percentage of the virus. Serological tests of foundation stocks of 10 standard American potato varieties and the virus X immune potato seedling 41956 (supplied by the writer) conducted by D.H.M. van Slogteren of the Lisse Laboratory during the summer of 1954, showed all to be carriers of virus S.

The symptoms produced by virus S in most European potato varieties are very difficult to describe because of their variability and indistinctness, and in general infected plants are also difficult to recognize in the field. Under certain conditions, however, many varieties show early symptoms as slightly stunted, rather delicate plants with open growth, weak stems, and slightly lighter colored leaves with a very weak rugosity as deep-veined leaves. Older intected plants are somewhat flaccid. Smaller tubers are produced by virus S infected plants.

A distinct mild virus X-like mottle is often seen in virus S infected plants of the varieties Bevelander, Koopman's Blauwe, Profijt and Souvenir. Leaves of older infected plants of the varieties Gloria, Libertas, Profijt and Yesselster are slightly bronzer in color with numerous small necrotic lesions on the upper surface.

Virus S has been tuber plug graft and sap transmissible to potato. No positive results have been obtained using aphids *(Myzus persicae)*. Weak and strong strains of the virus have been reported. Electron photographs have shown virus S to be rod shaped.

Inoculations by graft and/or sap to tobacco, *Nicotiana glutinosa*, *Physalis floridana*, *Nicandra physioloides*, *Datura stramonium*, and tomato have yielded negative results.

In the Netherlands the varieties Alpha and Foran have shown some field resistance to the virus.

Research work in the Netherlands has also shown that clonal selection through field indexing, together with serological diagnosis, should be followed to produce seed of foundation grade free from virus S.

Evidence to date indicates that virus S may be wide spread in the older potato varieties in this country.

LUTZ, J. M., HERBERT FINDLEN AND JOHN HANSEN

EFFICIENCY OF VARIOUS METHODS OF WASHING RED RIVER VALLEY POTATOES

Presoaking was the most effetcive means of facilitating soil removal. This can be accomplished either in a soak tank or by wetting down the potatoes in a bin, one day before washing.

Increased efficiency of washing was also obtained by increasing the length of time in the washer and drying the adhering soil before washing. A drum washer was only slightly more effective than a soak tank when the same time interval was used for both. Nither warming the wash water nor use of a detergent were of practical value.

Potatoes susceptible to injury were damaged by a too rigid washing process.

MC ANELLY, CHARLES, JESS FULTS, MRS. MERLE PAYNE

A PRELIMINARY ELECTROPHORETIC AND CHROMATOGRAPHIC STUDY OF POTATO LEAFROLL

In certifying potatoes for seed it would be convenient to have a simple chemical test that would show the presence or absence of a virus in plant tissues. It has been shown that the presence of Tobacco Mosaic Virus in the tomato plant tissues was correlated with the appearance of a new protein component in the electrophoretic pattern and on chromatograms.

Potatoes from indexed stocks were used for the chromatographic and electrophoretic tests. One eye from each tuber was planted in the greenhouse for the usual indexing procedure. The remaining eyes were ussd for the chromatographic and electrophoretic tests.

ODLAND, T. E. AND J. E. SHEEHAN

THE RESPONSE OF IRISH POTATOES TO DIFFERENT AMOUNTS AND RATIOS OF NITROGEN, PHOSPHORIC ACID, AND POTASH WHEN GROWN IN CONTINUOUS CULTURE

Potatoes are generally grown in continuous culture on commercial potato farms in Rhode Island. Heavy fertilizer applications ranging from 1 to 1½ tons per acre of a 5-10-10 or 6-12-12 grade has been the usual practice. This usually results in heavy accumulations of phosphoric acid and potash in the soil after a few years and adjustment of grade and amount of fertilizer to meet the new conditions is necessary for best results.

Different amounts of a 6-12-12 potato fertilizer was applied over a 10 year period at the Rhode Island Experiment Station. Green Mountain and Katahdin varieties were used. The amounts of fertilizer ranged from 1250 to 2500 pounds per acre. There was no consistent increase in yield from applications of more than 2000 pounds per acre.

In the fertilizer ratio experiment covering the same period of years, there was a consistent increase in yield with increasing amounts of nitrogen in the fertilizer from 90 to 120 pounds per acre. No significant increases in yield resulted from increasing the P_2O_5 from 90 to 225 pounds per acre or increasing the K_2O from 135 to 270 pounds. In each case there was a low, medium and high application of each nutrient with the other two being kept constant.

Data were obtained on specific gravity of tubers, keeping qualities and per cent of No. 1 potatoes. There were 4 replicates of all treatments using 1/20 A randomized plots.

It is concluded that under similar conditions, where potatoes are grown in continuous culture, the nitrogen content of the fertilizer should be gradually increased until a ratio approximating a 1-1-1 is reached. An application of 1500 to 2000 pounds per acre of an 8-12-12 or 10-10-10 grade will, in most instances, supply all the nutrients needed by the potato crop.

RIEMAN, G. H., D. C. COOPER AND DONALD A. YOUNG

THE HINDENBURG RUSSET CHARACTER IN RELATION TO SCAB

The flaked type of potato tuber russeting characteristic of the Hindenburg variety was found to be associated with resistance to common scab, caused by *Streptomyces scabies* (Thaxt.) Waks. and Henrici, in a seedling population of 90 individuals derived from russeted scab-resistant parents. The group of seedlings with heavy russet periderms exhibited more resistance than the light russet and the smooth periderm groups. Significant differences in resistance were found between the heavy russet and light russet classes and between the heavy russet and the smooth classes at the 1% level. No significant difference in resistance was noted between the light russet and the smooth classes. Highly resistant individuals occurred in all three classes indicating that genes responsible for resistance to scab may act independently of genes responsible for russeting. These results suggest that major genes for resistance to scab were linked with genes for the flaked type of tuber russeting.

SAIDAK, WALTER J. AND ORA SMITH

USE OF PLANT TISSUE TESTS IN POTATO NUTRITION STUDIES

The experiments were conducted during the 1954 growing season in Wyoming County, New York. One experiment consisted of a factorial fertilizer experiment with two levels of N. P_2O_5, K_2O, and MgO fertilizer. The Russet Rural variety was used. Petiole samples for tissue analysis were taken 41, 51, 60 and 71 days after planting.

Statistical analysis of the results indicated that the N and K_2O fertilizers increased yields. Highest yields were associated with the following soluble tissue constituents: N — 1300 to 800 p.p.m., P — 80 to 40 p.p.m., K — 6750 to 4000 p.p.m., Mg — 145 to 120 p.p.m. N fertilizer increased the levels of tissue N and tissue P. The amounts of N and Mg found in the tissue were depressed by a high K_2O fertilizer level. K_2O fertilizer also increased the tissue K. Tissue Mg increased as the MgO fertilizer level was raised. A positive correlation was found between tissue K and yield.

The second experiment consisted of a plant nutrient survey. Petiole samples, soil samples, and yields were taken at each of eleven farms.

A positive correlation was found between tissue test N and soil test N, of the farms sampled. Tissue test Mg and soil test Mg were positively correlated. A positive correlation between total and U.S. #1 size yields and soil test P was also found.

SALUNKHE, D. K. AND L. H. POLLARD

MICROSCOPIC OBSERVATIONS OF STARCH GRAINS IN RELATION TO MATURITY AND QUALITY OF POTATOES AND LIMA BEANS

Microscopic observations of starch grains from various anatomical parts of potato tuber were made in 1953. These observations indicate the variations in distinctness of lamellae. The lamellae of starch grains of Russet Rural tubers

were more distinct than those of Kennebec. Lamellae and hylums (hilums) of starch grains of tubers of high specific gravity and tubers from early planting were more distinct than those of low specific gravity and from late planting (of the same specific gravity) respectively. These observations suggest that the table qualities of potatoes may be ascertained by microscopic examination of starch grains.

Microscopic observations of starch grains of lima beans were made in 1953 and 1954 to study the effect of maturity of beans on the size, shape and structural development of hylum of starch grains of lima bean varieties — Clark's Bush, Limagreen, and Fordhook 242. From the results it is concluded that the starch grain becomes larger in size, more regular in shape, and progressively prominent in hylum as the physiological maturity of lima beans advances. This method of studying the microscopic structure of starch grains of lima beans may be adapted by canning companies to estimate when the field is ready to harvest without much loss of yield and quality.

SCHARK, ALLEN E., C. E. PETERSON AND FRANCES A. CARLIN

THE INFLUENCE OF VARIETY ON THE SPECIFIC GRAVITY-MEALINESS RELATIONSHIP OF POTATOES

Seven potato varieties grown in Iowa were evaluated by a taste panel of three judges to determine the relationship of specific gravity of tuber samples and mealiness of the cooked product. Differences between the mealiness scores for varieties averaged over all specific gravity classes were highly significant. Thus there was some factor other than specific gravity that influenced the evaluation of mealiness by the judges. All of the judges were affected in the same way, since certain varieties were consistently scored higher in mealiness and others were scored lower. Apparently specific gravity should be used in conjunction with other tests or observations in assessing mealiness of baked potatoes.

A significant linear relationship was found between mealiness scores and specific gravity of potato tubers. The relationship between specific gravity of tuber samples and mealiness scores remain constant over the range of specific gravity used in this experiment. The judges were able to discern differences at high as well as at the low range of tuber specific gravity. The judges did not differ significantly in their ability to score mealiness by the sensory methods used. The statistical analysis of mealiness scores showed no significant differences due to judges, or to interactions of judges x varieties, and judges x specific gravity classes.

SCHOENEMANN, JOHN A.

THE EFFECT OF LEVEL OF NITROGEN FERTILIZATION ON THE YIELD AND QUALITY OF THE RUSSET BURBANK POTATO WHEN GROWN IN WISCONSIN

Potatoes of the Russet Burbank variety were grown in plots located on light sandy soil in central Wisconsin and on a sandy loam soil in northern Wisconsin in 1954. Standard recommended cultural practices, including regular irrigations, were used with the exception of varying the amount of nitrogen side-dressed during the early part of the growing season. All plots received a basic application of a complete fertilizer (6-6-18) broadcast plus an additional uniform amount of fertilizer (5-20-20) in the row at planting time. Sidedressings of ammonium nitrate ranging from zero to 800 pounds per acre at the northern Wisconsin location and from zero to 1200 pounds per acre in the central Wisconsin location were made when the plants were 12 to 15 inches tall. Split applications at two and four week intervals were also made at one of the plot locations.

Results from the 1954 season indicate that there appears to be little or no benefit derived from applying more than 200 to 300 pounds of ammonium nitrate per acre as a single sidedressing application. Larger applications, however, could probably be utilized to some advantage if split into two or three sidedressings applied at regular intervals.

Increasing the amount of nitrogen applied tended to increase the yield of tubers 10 ounces in weight and over, decrease the yield of tubers under 1⅞", and increase the yield of misshapen ("knobby") tubers. High amounts of nitrogen also tended to prolong the blossoming period, and delay the maturity of both vines and tubers. When applied to potatoes growing on a light sandy soil, high amounts of nitrogen seemed to have little or no effect on the specific gravity of the tubers at harvest

time. Tubers harvested from plots grown on a sandy loam soil, however, tested progressively less in dry matter content as the amount of nitrogen sidedressed was increased.

Plots of the same variety, using similar nitrogen treatments are again being grown at these same two locations during the present growing season.

SHALLENBERGER, R. S. AND ORA SMITH

THE BROWNING REACTION IN POTATO CHIPS

Potato constituents responsible for the development of color in chips were studied. Four potato varieties harvested at three different dates and stored at four temperatures for prolonged periods of time were used in this study. Samples taken were analyzed for potato chip color, percentage moisture, ascorbic acid, total nitrogen, protein nitrogen, non-protein nitrogen, amino, basic and amide nitrogen, and total, reducing, and non-reducing sugars. No obvious correlation existed between chip color and any single potato component except total sugars ($r = 0.84$) and reducing sugars ($r = 0.89$).

An attempt to quantitatively account for the color intensity of potato chips was made using known reactants at concentrations found in the potato tubers. It was found that the total sugars, total nitrogen and ascorbic acid had to be used to develop 70-80% of the total color intensity of potato chips.

A scheme for development of color in chips is given.

SHARMA, K. N. AND N. R. THOMPSON

RELATIONSHIP OF STARCH GRAIN SIZE TO POTATO QUALITY

Six varieties of potatoes were grown at two locations in Michigan in 1954. They were tested for specific gravity and for starch grain sizes.

The percentages of starch area occupied by large (above 75 microns) and small (below 25 microns) starch grain sizes seem to be two physical factors determining the specific gravity of potatoes.

SHEEHAN, J. E. AND T. E. ODLAND

A QUARTER CENTURY OF POTATO VARIETY TESTING IN RHODE ISLAND

During the period 1930-1954 a total of 28 old and new varieties of potatoes as well as many seedlings were included at the Rhode Island Agricultural Experiment Station in the National Potato Breeding program. All seed was furnished each year by the Division of Vegetable Crops and Diseases of the United States Department of Agriculture. The varieties were grown with standard cultural practices. Yields were obtained and notes taken on disease resistance, keeping quality, specific gravity of tubers and occasionally other specific characters of the plants or tubers. As newer varieties have been developed they have replaced the older ones — only three varieties are at present included that appeared in the test in 1930. More effective insect and disease control has helped increase yields of all varieties. Although many of the newer varieties are high yielders they are not of as good eating quality as some of the older varieties. More emphasis in research is needed on improving the eating quality of potatoes.

SMITH, ORA, AND R. S. SHALLENBERGER

MODEL SYSTEM STUDIES OF POTATO CHIP COLOR

Model system studies were made in order to obtain substantial background information on browning reactions responsible for color development in potato chips. The model system technique was designed to simulate potato chip frying.

Twenty amino acids were reacted at different concentrations with glucose, sucrose and ascorbic acid. Two, three and four component systems were also studied. Color was measured using the Hunter Color Meter.

Results showed that more color was generally developed with the mono-amino acids at a standard time. Less color was developed with the amides and basic amino acids, in that order. One exception was the basic amino and lysine which develops more color than other basic amino acids.

An important facet of these studies was the observation that the apparent

order of reactivity of the amino acids changes significantly at different concentrations of amino acid.

Spectrophotometric data indicated that the color of the pigment developed is qualitatively the same regardless of the amino acid of nitrogen-free compound used.

Attempts were made to inhibit the model reactions. Several compounds were studied as inhibitors of the model system reactions. In all cases, $NaHSO_3$ was found to be superior to HCl or citric acid.

STEVENSON, F. J.

BREEDING VARIETIES OF POTATO RESISTANT TO DISEASES AND INSECTS

Varieties of potato resistant to diseases and insects will help the farmer in his battle against crop enemies and reduce the cost of production. Potato breeding in the United States began about 100 years ago in an effort to control late blight. Many varieties were produced by growers and amateur breeders, but none was resistant to late blight. Breeding lapsed for a time. It was resumed in 1910 by the United States Department of Agriculture in cooperation with State agricultural experiment stations under the National Potato-Breeding Program.

Through the years yield and market and cooking qualities, with special emphasis on higher percentage of total solids have been given first consideration, but resistance to a number of diseases and injury by certain insects have an important place in our work.

From the domestic and foreign varieties classified as *Solanum tuberosum* we have isolated many characters resulting either from mutations or species hybrids. A list of the important characters includes wide adaptation; early, medium, and late maturity; many shapes; many skin and flesh colors; various degrees of russeting; various depths of eye; and wide range in yielding ability and dry-matter content. Resistance to the following diseases and insects also have been found: Mild mosaic, latent mosaic, rugose mosaic, leaf roll, net necrosis, yellow dwarf, late blight of vines, tuber rot, common scab, potato wart, verticillium wilt, brown rot, hopperburn, flea-beetle injury, and aphid injury. Many species hybrids have been made, but immunity from some of the physiologic races of late blight is the most important character so far contributed by a wild species that has been valuable in the production of improved varieties of potato.

The lists giving the certified seed available for the 1954 crop includes 35 varieties that were released under the National Potato-Breeding Program. Most of these are resistant to one or more of the diseases and insects listed above. Some of them are resistant to several diseases. The 35 varieties account for about 62 per cent of the approximately 44 million bushels of certified seed produced in the United States and about 80 per cent of the 10½ million bushels certified in the 3 Maritime Provinces of Canada.

WEBB, R. E., R. V. AKELEY, AND F. J. STEVENSON

LEAF ROLL RESISTANCE IN *SOLANUM TUBEROSUM* L.

Four potato varieties (Katahdin, Metador, Imperia, and Kerkov Triumf) and 19 leaf-roll-resistant seedlings were tested for their relative resistance to infection with the leaf roll virus in the greenhouse. The 4 named varieties and 13 of the seedlings were readily infected when leaf-roll infected aphids, *Myzus persicae* (Sulz.), were confined to the plants under pliofilm cages. Subsequent inoculations to the 6 highly resistant seedlings with aphids and tuber-plug grafts from leaf-roll-infected tubers indicated that none was immune from the virus. The virus was not readily recovered, however, by aphids from infected plants of the 6 seedlings. Seedling X927-3 appeared to be the most highly resistant to aphid inoculation (2 of 25 plants infected) and tuber-plug graft inoculation (58 per cent of 50 tuber-grafted plants infected). Seedling B 24-58 proved to be a symptomless carrier of the virus under the conditions of the tests. Preliminary results indicated that the leaf roll resistance of seedling B 2834-3 may be partially due to its resistance to the vector. In a replicated test under field conditions in which 10 viruliferous aphids were placed on each of 100 plants of Chippewa, Katahdin and seedling X927-3, 97, 59 and 3 plants became infected, respectively. Some evidence showing that high temperatures during critical stages may materially lower the resistance to infection shown by seedling X927-3 and other resistant seedlings was obtained.

WERNER, H. O.

MANAGEMENT FACTORS INFLUENCING THE GERMINATION OF POTATO SEED

The percentage of seed germination was improved by fermenting the crushed berries for one or two days before washing and drying the seed, but with fermentation continued beyond two days, germination percentages diminished rapidly. Under the environmental conditions in the greenhouse in Lincoln, where daytime greenhouse temperatures were over 100° F. on many days before most of the berries were harvested, there appeared to be a decrease in germination: (1) when the harvesting was delayed much beyond 60 days after pollination; (2) when harvested berries were held for a long time before extracting the seed; (3) with length of time extracted seed was held.

WERNER, H. O.

FURTHER OBSERVATIONS OF SOME ANOMALOUS MORPHOLOGICAL DEVELOPMENTS WITH THE POTATO PLANT

Kodachromes will be shown of a number of unusual tuberization phenomena differing from those shown at the 1954 meeting. The most distinctive are flowers and berries produced directly on tubers which were produced in inflorescences. Some of the implications of these tuber manifestations will be considered.

WILLARD, MILES J., JAMES CORDING, JR., R. K. ESKEW, P. W. EDWARDS, AND JOHN F. SULLIVAN

POTATO FLAKES. A NEW FORM OF DEHYDRATED MASHED POTATOES. REVIEW OF PILOT PLANT PROCESS.

The processing variables in the pilot-plant production of dehydrated mashed potatoes using a double drum drier are discussed. A newly-developed pre-cooking step makes it possible to improve and control the texture of the final reconstituted product and permits the use of potatoes of lower solids content previously not considered suitable for dehydrated mashed potatoes. A possible explanation of this effect based on a modification of the starch within the cells is advanced.

The effects of other factors such as flake thickness, density and size, dryness, and selection of raw material are reviewed.

WOLCOTT, A. R. AND N. K. ELLIS

VARIETAL RESPONSE TO CLIMATE AND CULTURE AS RELATED TO INTERNAL BROWNING IN POTATO TUBERS

Twenty potato varieties and seedling lines were planted, using different cultural practices, on muck soils in northern Indiana. Variations in internal browning injury were correlated with variations in growth and tuberization phenomena that are known to be strongly influenced by photo-period and temperature. Internal browning was found to develop under conditions of fluctuating vine and tuber growth that are known to give rise to resorption of stored material from the tubers. Periods of rising temperature in August were associated with resurgent terminal vine growth, resorption of smaller tubers and initiation of necrotic symptoms in larger tubers. Cool temperatures in September prolonged life of vines, promoted regrowth and roughness of tubers. Alternating periods of high temperature during the short days of September were conducive to severe internal browning. Extensive resorption of tubers during September in 1954 was associated with a sharp increase in browning over the previous year. Late planting, high water table and excessive nitrogen promoted extension of growth into this particularly damaging period.

The early necrotic symptoms found during August were of the internal brown spot type, ranging from diffuse flecking to irregular blotches and large central lesions. Injury observed as vines were turning color was of the corky ringspot type. After vines were dead, necrosis with scattered cavities was found, of a form recognized in Europe as canker type rust spot. The different types were found together in the same plots of most varieties, and even in the same hills. Sequential appearance during the season, and simultaneous occurrence in the same variety suggest strongly that these types are related in origin but differ in pattern as a result of the different physiological age of tuber tissues at the time that injury occurs.

WITZ, RICHARD L.

EQUIPMENT TO MEASURE THE RESISTANCE OF POTATOES TO PRESSURE, ABRASION, AND IMPACT BRUISING

Increased use of potato harvesting equipment and large bin storages have emphasized the need for developing varieties of potatoes resistant to bruising. Methods of measuring the resistance of various varieties and new selections to bruising would reduce time and cost in potato breeding work.

Three testers were developed to measure each of the types of bruising, namely: pressure, abrasion, and impact. The pressure bruiser measures the pressure required for a 0.155 in dia. plunger to puncture the surface of the potato. The abrasion tester measures the torque required to remove the skin from the potato with a ¾ and 3 in. emery wheel. The impact tester measures the penetration made by a ¼ inch steel ball when driven against the potato with a given impact. Each tester has given significant results between various varieties, between various soil conditions, and between various potato treatments.

Information on the results of the tests made and description of the equipment is in Agricultural Engineering (Vol. 35, No. 4. pp. 241-244, April 1944).

MINUTES OF EXECUTIVE COMMITTEE MEETING

Potato Association of America

Michigan State University

East Lansing, Michigan

September 5, 1955

9:30 A.M.

Meeting called to order by President Hawkins.

Members Present:

J. C. Campbell, J. W. Scannell, A. Hawkins, R. W. Hougas, C. W. Frutchey, P. J. Eastman, W. G. Hoyman.

Visitors:

F. J. Stevenson, P. Mosher, M. Koehnke, G. Koehnke, W. J. Hooker, O. C. Turnquist, C. McAnelly.

Members Absent:

W. H. Martin, Mrs. J. B. Adams.

The minutes of the Executive Committee Meetings held at Fort Collins, Colorado, and Estes Park, Colorado, in August, 1954 were accepted as published in the American Potato Journal. *32*: 36-37.

N. M. Parks presented a comprehensive report of the Policy Committee. Report accepted.

Action was taken on the following items of the Policy Committee Report.

1. *Motion*

It was moved by C. W. Frutchey that a Policy Committee be established consisting of five active members of the Association and that one member of the Committee be the immediate past-president. Seconded by P. J. Eastman. *Motion carried.*

2. *Motion*

It was moved by P. J. Eastman that a permanent Editorial Board for American Potato Journal be established. Seconded by J. C. Campbell. *Motion defeated.*

New Advertising Agent:

A review of the advertising agent situation was presented by Arthur Hawkins. The services of the C. S. Macfarland Company, as advertising agent for the American Potato Journal, were terminated January 30, 1955. The new advertising agent for the American Potato Journal is: George F. Koehnke, 20 E. Jackson Boulevard, Chicago 4, Illinois.

Motion:

It was moved by P. J. Eastman that appreciation be expressed to the Publications Committee, especially H. D. Berry and G. V. C. Houghland, for developing the new frontispiece for the Journal. Seconded by J. W. Scannell. *Motion carried.*

Session recessed at 12:50 Noon.

Meeting resumede at 1:30 P.M.

Annual Potato Handbook

A discussion of the proposed new annual supplemeent of the Journal was presented by C. W. Frutchey. The work concerned with the preparation and distribution of this issue is well underway. Several names were proposed for the supplement.

Motion:

It was moved by J. C. Campbell that the new supplement be called the POTATO HANDBOOK and that the frontispiece carry the name, the year, the issue number and the theme-title of the issue. Seconded by W. G. Hoyman. *Motion carried.*

The major theme of the first issue of the POTATO HANDBOOK will be potato certification.

Advertising rates of the first issue will be:

Full page	$100
Half page	50
Quarter page	35
Back Cover	160
Inside front cover	130
Inside back cover	130

Motion:

It was moved by C. W. Frutchey that the price of individual copies of the HANDBOOK be two dollars. Seconded by P. J. Eastman. *Motion carried.*

Motion:

It was moved by W. G. Hoyman that copies be distributed to state certification agencies in accordance with the size of their ad in the POTATO HANDBOOK. Seconded by C. W. Frutchey. *Motion carried.*

Group Memberships

Motion:

It was moved by C. W. Frutchey that no new one dollar group memberships be made. Seconded by P. J. Eastman. *Motion carried.*

Change in Date of 1955 Annual Meeting

Motion:

It was moved by W. G. Hoyman that the 1955 business meeting of the Association be held at 4:30 P.M., September 7 rather than at 9:00 A.M., September 8. Seconded by P. J. Eastman. *Motion carried.*

Place of 1956 Annual Meeting

Motion:

It was moved by W. G. Hoyman that the Executive Committee recommend holding the next annual meeting of the Association at Cincinnati, Ohio, December 6-9, 1956, in conjunction with the annual meeting of the American Phytopathological Society. Seconded by P. J. Eastman. *Motion carried.*

Meeting adjourned.

MINUTES OF ANNUAL MEETING

Potato Association of America

Conservation Building
Michigan State University
East Lansing, Michigan

September 7, 1955

4:40 P.M.

Meeting called to order by President Hawkins.

Motion:

It was moved by R. H. Larson that the minutes of the 1954 Annual Meeting be accepted as published in the American Potato Journal. *32*: 36-39. Seconded by O. C. Turnquist.....*Motion carried.*

The minutes of the 1955 Exerutive Committee meetings were approved as read.

Committee Reports

The Treasurer's Report was presented by J. C. Campbell. Report accepted. Copy attached.

The Report of the Membership Committee was presented by O. C. Turnquist. Report accepted. Copy attached.

The Report of the Sustaining Membership Committee was presented by P. J. Eastman. The Association has fifteen Sustaining Members at present. Report accepted.

C. W. Frutchey suggested that a letter of appreciation be written, by the chairman of Sustaining Membership Committee, to each of the Sustaining Members who were unable to attend the annual banquet.

The Auditing Committee Report was presented by H. O. Werner. Report accepted. Copy attached.

The Potato Certification Committee Report was presented by C. W. Frutchey. Report accepted.

The Report of the Policy Committee was presented by N. M. Parks. Report accepted. Copy attached.

The Potato Introduction Committee Report was presented by R. W. Hougas. Report accepted.

The Potato Virus Committee Report was presented by W. G. Hoyman. Report accepted.

Motion:

It was moved by N. M. Parks that the matter of the revision of the Constitution and By-Laws be referred to the Executive Committee for their review and recommendations; that the recommendations of the Executive Committee be presented at the next annual meeting for action. Seconded by J. C. Campbell. *Motion carried.*

Potato Association of Northwest Europe.

Ora Smith announced that potato researchers from several north European countries approached him, during his recent trip abroad, concerning their interest in establishing a European organization similar in nature to the Potato Association of America.

Motion:

It was moved by J. C. Campbell that the Potato Association of America go on record as follows:

(1) That we are pleased to learn of the interest in developing a similar organization in Europe, namely the Potato Association of Northwest Europe.
(2) That we are glad to offer encouragement and advice or other aid to assure this proposed Association of success in their organization and functions.
(3) That we wish them success in their plans for a potato publication and
(4) That we hereby appoint Ora Smith to act as liaison between these two organizations.

Seconded by G. H. Rieman. *Motion carried.*

International Relations Committee

E. H. Casseres of the Inter-American Institute of Agricultural Sciences, Costa Rica, reviewed the cooperative program of training and research underway between 21 of the Latin American Countries. Special mention was made of the potato research discussions included in the program of the third Latin American Plant Research Conference recently held in Colombia, S. A.

Motion:

It was moved by G. H. Rieman that the Association establish an International Relations Committee comprised of leaders in potato research and improvement throughout the world to promote and facilitate the improvement of the cultivated potato at the international level.

Seconded by N. M. Parks. *Motion carried.*

Motion:

It was moved by R. H. Larson that the Potato Association of America explore the possibilities of the Food and Agriculture Organization of the United Nations, or some similar international agency, purchasing the microscopic stain test, recently developed by Henner Lange, Bernadottestrasse 38, Hamburg, Germany, for the detection of the Potato Leaf Roll Virus in plant tissue, with the object of making this stain test available to the scientific world, which would give all potato research workers an important tool for use in the study of this wide spread, very destructive virus and in the development of immune varieties. Seconded by L. A. Dionne. *Motion passed.*

Changes in Editorial Staff of the Journal

Motion:

It was moved by Ora Smith that the following change be made in the editorial staff of the Journal:

(1) that William H. Martin be appointed Honorary Editor
(2) that J. C. Campbell be appointed Editor and
(3) that E. S. Clark be Associate Editor.

Seconded by G. H. Rieman. *Motion carried.*

Changes in Frontispiece of Journal

Motion:

It was moved by A. J. Pratt that the suggestion of eliminating color, reducing or eliminating the picture on the front page and listing the table of contents on the front page be made effective at the discretion of the Executive Committee. Seconded by R. H. Treadway. *Motion carried.*

New Officers

The Nominations Committee Report was presented by Ora Smith.

Nominations:

President — C. W. Frutchey
Vice President — R. W. Hougas
Director (3 Years) — O. C. Turnquist

R. H. Larson moved that nominations be closed and that a unanimous ballot be cast for the slate. Seconded by J. C. Campbell. *Motion carried.*

Resolutions

The Report of the Resolutions Committee was presented by J. W. Scannell. The Association expressed appreciation to Michigan State University for the use of their facilities, to A.I.B.S. for their cooperation and especially to the Local Arrangements Committee, namely, W. J. Hooker, E. J. Wheeler and N. M. Thompson.

Place and Date of Next Annual Meeting.

Motion:

It was moved by W. G. Hoyman that the Secretary canvas the members of the Association by mail, before October 1, 1955, with regard to the place and date of the next annual meeting. Seconded by W. J. Hooker. *Motion carried.*

Meeting adjourned.

R. W. Hougas,
Secretary.

FINANCIAL STATEMENT

Statement for 8 months — December 1, 1954 to July 31, 1955

RECEIPTS

Cash on hand and in bank, November 30, 1954	$ 5,004.23	
Annual Dues	4,216.24	
Sale of Advertising	1,217.36	
Sale of Reprints	1,220.90	
Sale of Back Issues	85.42	
General	5.00	
Sale of Index	15.00	
TOTAL RECEIPTS		$11,764.15

DISBURSEMENTS

Printing of Journal	$ 4,521.14	
Printing of Reprints	676.50	
Mailing & Supplies	537.25	
Dues (AIBS)	100.00	
Purchase of Typewriter	90.00	
Auditing of Books	100.00	
Back Issues	80.25	
Salaries, E. Campbell (Treasurer's Work)	440.00	
J. Campbell (Editorial)	333.00	
E. Clark (Editorial)	200.00	
Extra Office Work	65.00	
General (Refunds, Advertising, Telephone)	36.03	
TOTAL DISBURSEMENTS		$ 7,179.17
CASH ON HAND AND IN BANK, JULY 31, 1955		$ 4,584.98

The above balances include the Lelah Starks Fund of $520.08. No payments were made from this account during this period.

Accounts Receivable (Approximate)

Reprints (Billed for and not paid)	$ 778.00
Advertising (Through July)	722.70
TOTAL	$ 1,500.70

Accounts Payable

Reprints (May)	$ 94.50
July Journal	536.50
Engravings	86.90
Miscellaneous	10.46
TOTAL	$ 728.36

Accounts Receivable less Accounts Payable $ 772.34

NEWS AND REVIEWS

POTATO IMPORT REGULATION ISSUED

A regulation which specifies minimum grade and size requirements applicable to Irish potatoes imported into the United States was issued November 8 by the U. S. Department of Agriculture. The import regulations are authorized by Section 608e of the Agricultural Marketing Agreement Act. A similar regulation on potato imports was in effect last season. The regulation will be effective from November 14, 1955 through June 30, 1956.

The importation of round white or red skin varieties is limited to the U. S. No. 1 or better grade, 2¼ inches minimum diameter and 4 inches maximum diameter. Long variety potatoes, such as the Russet Burbank variety, must meet the requirements of the U. S. No. 2 grade, Size A, 5 ounces minimum weight, or the U. S. No. 1 grade, Size A, 2 inches minimum diameter or 4 ounces minimum weight. In addition, all imported potatoes have to be "generally fairly clean." The regulation does not apply to certified seed potatoes. Also, any lot not in excess of 500 pounds of potatoes may be imported without regards to the regulation.

Most of the potatoes imported into the United States come from Canada. The Canadian Fruit and Vegetable Inspection Service is designated as an authorized inspection agency for shipments of Canadian potatoes, and Canadian potato standards may be used on the same basis as comparable United States grade standards.

USDA ANNOUNCES GUIDES FOR SPRING VEGETABLES, SPRING MELONS, AND SPRING POTATOES

Acreage-marketing guides for 1956 crop spring vegetables for fresh use, spring melons and EARLY COMMERCIAL SPRING POTATOES were issued November 3 by the U. S. Department of Agriculture.

The Department recommended a total 1956 acreage for fresh spring vegetables 2 per cent below last year, a total acreage of spring melons equal to last year, and a 1956 acreage of EARLY COMMERCIAL SPRING POTATOES 13 per cent below last year.

The guides issued cover the 18 major spring vegetables and two spring melon crops that will be marketed in fresh form, principally during April, May, and June 1956, and 1956 early commercial spring potatoes.

The EARLY COMMERCIAL SPRING POTATO acreage guide for 1956, by States, amounts to a national total of 131,020 acres compared with 150,800 acres harvested in 1955. With average yields, the probable production from the guide acreages would be 39 million bushels.

The guides are part of an annual series. Guides for winter season fresh vegetables and EARLY COMMERCIAL WINTER SEASON POTATOES were announced in August 1955. Guides for summer, fall, and processing vegetables, sweet-potatoes and SUMMER *and* FALL SEASON POTATOES will be issued in January, 1956. Issued seasonally prior to planting time, the guides are designed to assist vegetable growers in planning production. Action by growers on the Department's recommended acreages is voluntary.

The Department said that if production is in line with the guides for 1956, and if marketings follow a normal time pattern for the season, supplies should be adequate to meet all requirements.

A more detailed report, "1956 Acreage-Marketing Guides, Spring Vegetables for Fresh Market," will be available for distribution through the State Agricultural Extension Services in spring vegetable States within a short time.

1956 ACREAGE-MARKETING GUIDES EARLY COMMERCIAL SPRING POTATOES

State	1956 Acreage Guide (Acres)	Percentage Guide is of 1955 Harvested Acreage (Per cent)
Early Spring:		
Florida	19,190	77
Texas	250	100
Group total	19,440	77
Late Spring:		
California	56,400	82
Louisiana	4,585	99
Mississippi	500	77
Alabama	19,935	72[1]
Georgia	590	98
South Carolina	6,500	100
Arizona	3,720	78
Texas	3,190	84
Oklahoma	500	100
Arkansas	1,270	98
Tennessee	1,300	100
North Carolina	13,090	94
Group total	111,580	89
All States	131,020	87

[1]Percentage of 1955 planted acreage.

Plant the suggested percentages of potatoes if you want to avoid another season of low prices.—*Ed.*

POTATO PEELING SERVICE ON THE INCREASE, ACCORDING TO USDA SURVEY

Restaurants and institutions are the principal customers of potatoes being marketed in ready-to-cook form, according to a survey of the potato peeling industry made by the U. S. Department of Agriculture. In 1954, according to unofficial estimates, these outlets used a total of 64 million bushels of potatoes.

In 1953, the peeled potato industry as a whole prepared about 3.2 million bushels. This amounted to approximately 5 per cent of the total quantity of potatoes used by restaurants and institutions.

At the time of the survey (August-September 1954), more than 100 plants were operating, and the service was available in nearly every metropolitan area throughout the country. Potato peeling plants are now producing french-fry sticks and crinkle-cut slices, slices for hash-browning, diced potatoes for salads and canning, and peeled whole potatoes for boiling and mashing. Charges for peeling ranged from 3 to 6 cents a pound.

The plants participating in the survey used three methods of peeling: Abrasive, caustic (lye), and steam. The plants using the abrasive method were the most numerous and peeled the most potatoes, although the plants using the caustic method peeled about twice as many potatoes per plant as the average plant using the abrasive method. Peeling losses with the abrasive method ranged from 10 to 48 per cent; with the caustic, 5 to 28 per cent. Data were insufficient to arrive at figures on losses by the steam method.

Packages in which the peeled potatoes were sold ranged in size from 12 ounces for retail stores to 60 pounds for institutions. The containers were largely of polyethylene or of paper that had been treated to improve its wet strength.

A copy of Marketing Research Report No. 105, "The Commercial Potato Peeling Industry (A Survey)" may be obtained from the Marketing Information Division, Agricultural Marketing Service, U. S. Department of Agriculture, Washington 25, D. C.

CHIPS ON THE TABLE — FRESH AND CRISP

One hot, humid, summer day in 1949, Patrick O'Brien ripped open a bag of potato chips and spread them on his desk. They were stale and limp. He picked one up and smelled it; that did it. He discarded the bag of chips and resolved to find a way to make potato chips stay fresher longer in hot weather.

Patrick O'Brien is president of Gordon Foods, Inc., in Atlanta, Georgia, and the bag of chips he threw away was made by his company. Like all potato chip manufacturers, he is acutely aware of the thousands of dollars lost when chips deteriorate on store shelves in summer.

Experimental work was started at Georgia Tech under Gordon Foods' sponsorship. A special incubator was built for aging bags of fried chips. Anti-oxidants used to retard rancidity in cooking oils were found to maintain the crispness and flavor of the chips, but objectionable odors developed. When Columbia activated carbon was packaged in the test bags, it removed the odor; furthermore, it proved to be just as effective by itself in preserving freshness and flavor as any of the anti-oxidants.

To protect the chips from moisture, a small quantity of silica gel was added to the activated carbon. This mixture maintained flavor, odor, and crispness of chips packaged in unsealed wax paper bags for more than a week under the severe test conditions of the incubator — the equivalent of at least two weeks of normal hot weather storage.

After this conclusive experimental work, small perforated cellophane packets of Columbia activated carbon and silica gel were included in

every bag of Gordon's potato chips. Gordon Foods calls them "Magic-Paks," and has a patent pending on the development. They are selling the packets to other potato chippers and to candy and drug packers throughout the United States. One of their customers is using "Magic-Pak" to prevent mold on packaged onions.

Before long, "Magic-Pak" will be retailed to housewives with the suggestion that the packet be used in the refrigerator to reduce odors, in salt shakers and sugar canisters to prevent caking, and in cereal and cracker boxes to maintain crispness and flavor.

—*Reprinted from* CHEMICAL PROGRESS, Vol. 1, No. 9
courtesy Union Carbide and Carbon Corporation

KERN COUNTY PLANS POTATO PRICE STUDY

The Kern County (California) Potato Growers Association has under consideration several independent methods of investigating the price spread between the producer and the consumer of Kern county potatoes, among the various media of distribution, viz: Transporter, broker, commission house, jobber, wholesaler, retailer, etc. The membership is vitally concerned with the question of certain abnormal price spreads in the distribution of its product to the consumer, which in some cases causes the consumer to pay a high price for the product while growers receive less than the cost of production.

In the same connection, the association reports it has received assurances from congressional representatives in Washington and the U. S. Department of Agriculture, that Kern county long white potatoes will be one of the commodities included in the USDA's Price Spread Study which will analyze the price spread between the producer and consumer of certain food items in the United States. The sum of $250,000 has been earmarked in the USDA's 1956 fiscal budget for this study.

The USDA further advised that the established price collecting agencies, such as the Fruit and Vegetable Market News Service and the Bureau of Labor Statistics, will collect the necessary price data at wholesale and retail levels for the Marketing Research Division. The USDA also indicated that the lack of retail potato prices by variety and state of origin is the principal gap in the price data which it hopes to fill. USDA concluded its communication by stating it would be very happy to have the co-operation of the Kern County Potato Growers Association in the Price-Spread Study, which will get under way with the 1956 early crop marketings.

—*Reprinted from* THE PACKER

USDA ANNOUNCES 1955 YEARBOOK OF AGRICULTURE, ENTITLED "WATER"

The U. S. Department of Agriculture recently announced publication of its 1955 Yearbook, a 752-page volume devoted to drought, floods, and the normal sources and uses of water.

Entitled *Water*, the book contains a wealth of information on all aspects of a subject that has become a major national concern — for industries, city people, foresters, conservationists, gardeners, and sportsmen, no less than for farmers, ranchers, and orchardists.

Its 95 chapters were written, mostly in nontechnical style, by 149 specialists in the Department of Agriculture, State agricultural colleges and divisions, and private and Federal organizations whose work pertains to water. The book has many drawings, maps, and photographs.

Among the subjects treated are: The importance of water in history; the need for water of people, animals, and plants; weather cycles; "cloud seeding;" desalting sea water; water and erosion; the care of watersheds; water laws; floods and their prevention; water for forests and range lands; irrigation in the West and East and for specific crops; drainage; managing watersheds for better fishing; wetlands and waterfowl; farming in dry regions; use of waste water by industries; water for gardens and lawns; pure water for rural homes; sewage disposal; teaching and learning about conservation; and research regarding water.

In the foreword to the Yearbook, Ezra Taft Benson, Secretary of Agriculture, writes about the challenge before us: "We have to know where water comes from and what happens to it. We have to know how much can be used and when, and how our land practices influence its behavior.

"We have to stop wasting water. We have to use it more efficiently in industry, in towns and cities, in general farming, and in irrigation, which is destined to be adopted in all parts of the Nation.

"We have to learn more about the control of floods at their sources as well as in the big rivers. That will take county, regional, and national planning — much more planning for the future than we have ever done.

"We have to look to the fields, the forests, and the hills that make up our watersheds, for the way we manage them affects the abundance and purity of the water farmers and city people need in increasing quantities . . . .

"We need an increased awareness among all Americans of the oneness of our physical resources. Just as many lives make up our one national life, so our agriculture has many parts of a single whole. Water, land, and people are inseparable components of one thing, our welfare. The subject of water can be viewed from the various aspects of soil conservation, agronomy, forestry, irrigation, wildlife, recreation, business, industry, law, and so on — but never alone."

The Yearbook of Agriculture is a Congressional document prepared in the Department of Agriculture and published under direct Congressional authorization. The Yearbooks are distributed mainly by Members of the Congress. It is also sold by the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at $2.00 a copy. The Department of Agriculture has no copies for general distribution. Requests for copies should not be sent to the Department or any of its employees.

(*Editor's Note*—A copy may be obtained free of charge from your Congressman.)